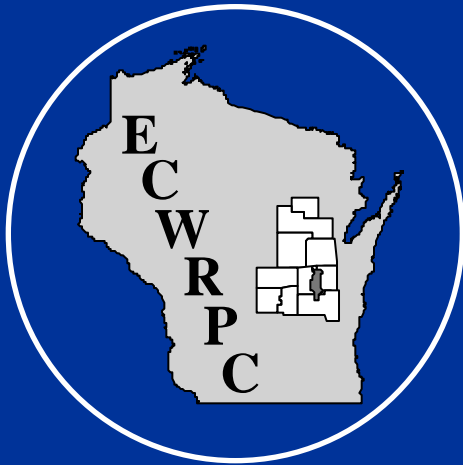


# Groundwater Recharge in East Central Wisconsin

Todd Verboomen  
Associate Environmental Planner  
East Central WI Regional Planning Commission



Over 35 Years of Service

Groundwater Protection: Science, Planning, and Action  
May 6, 2011

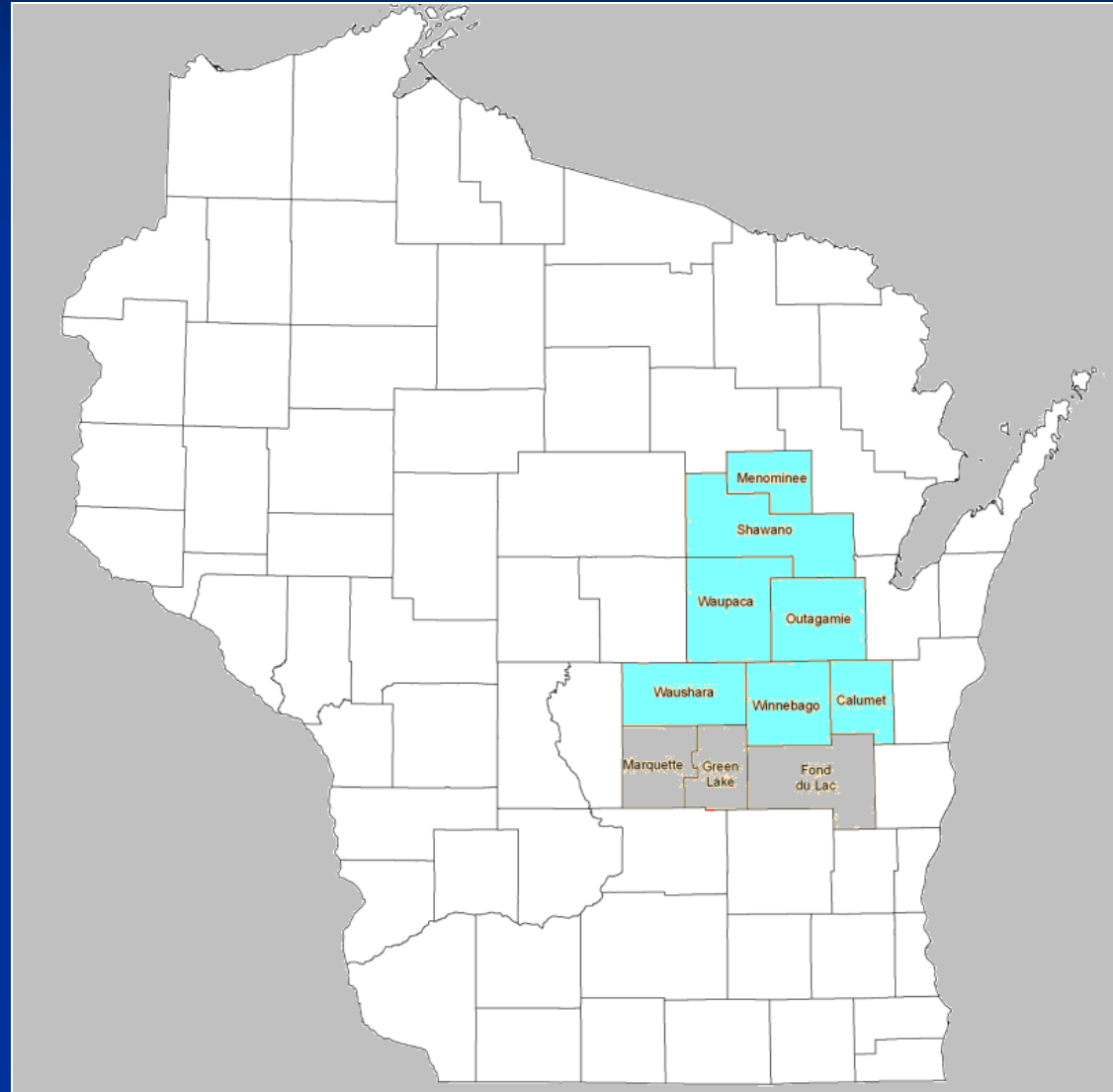
# East Central RPC's Region

## Member Counties

- Menominee
- Shawano
- Waupaca
- Outagamie
- Waushara
- Winnebago
- Calumet

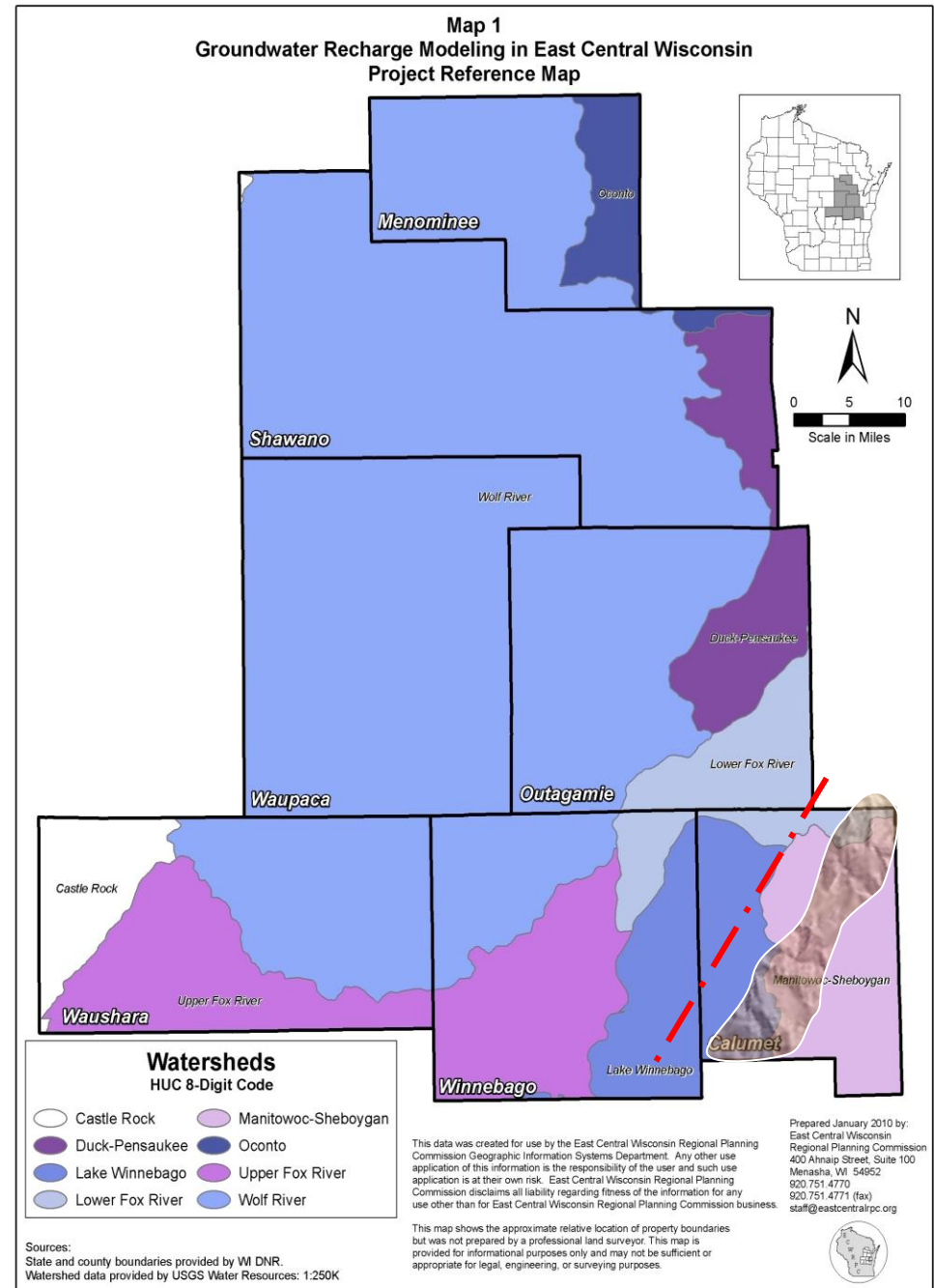
## Non-member Counties

- Marquette
- Green Lake
- Fond du Lac



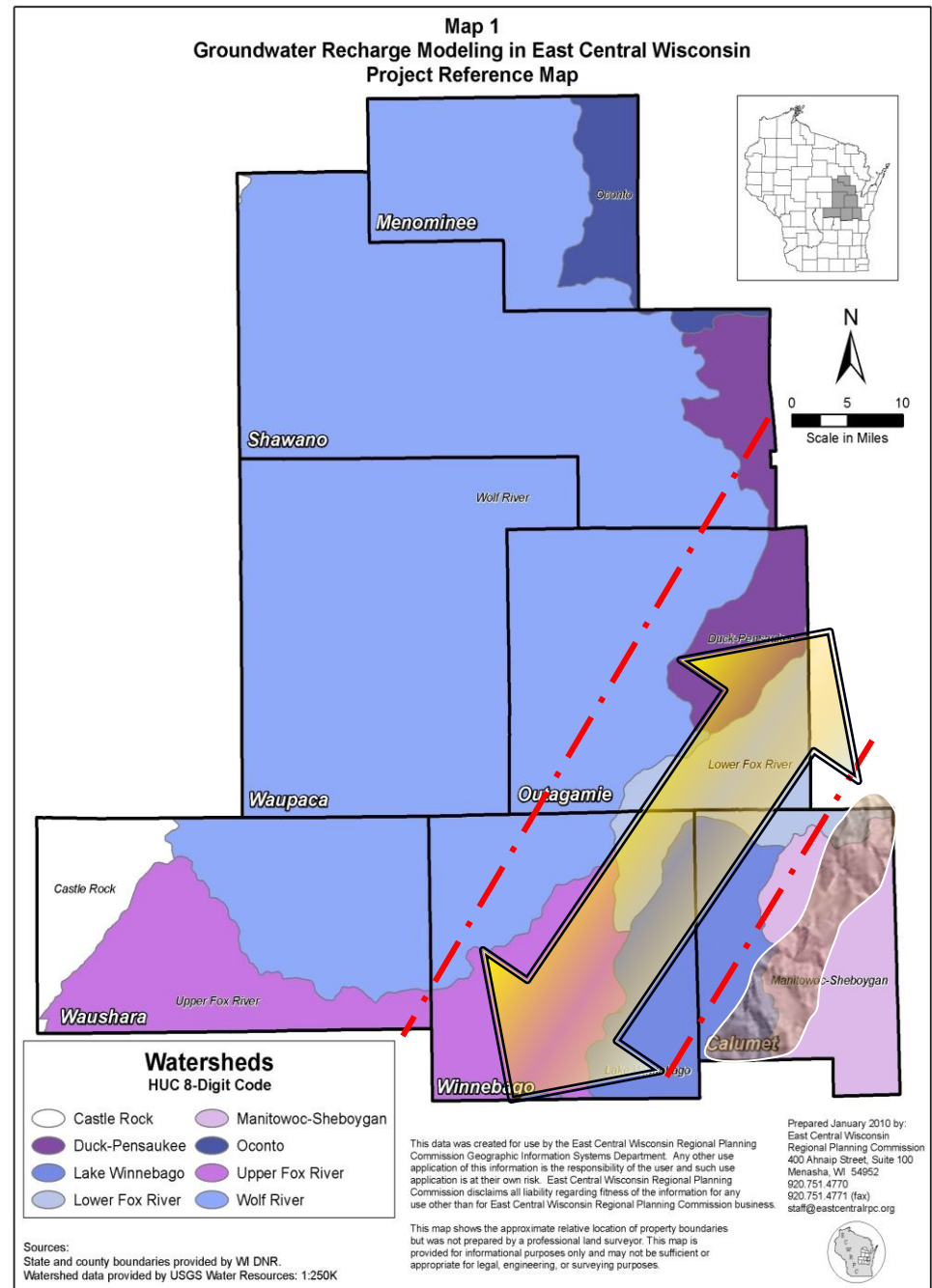
# East Central's Region

- Niagara Escarpment
  - Karst bedrock formation
  - High susceptibility to groundwater contamination
  - Large number of CAFOs throughout the area.
  - Village of Sherwood potable water problems



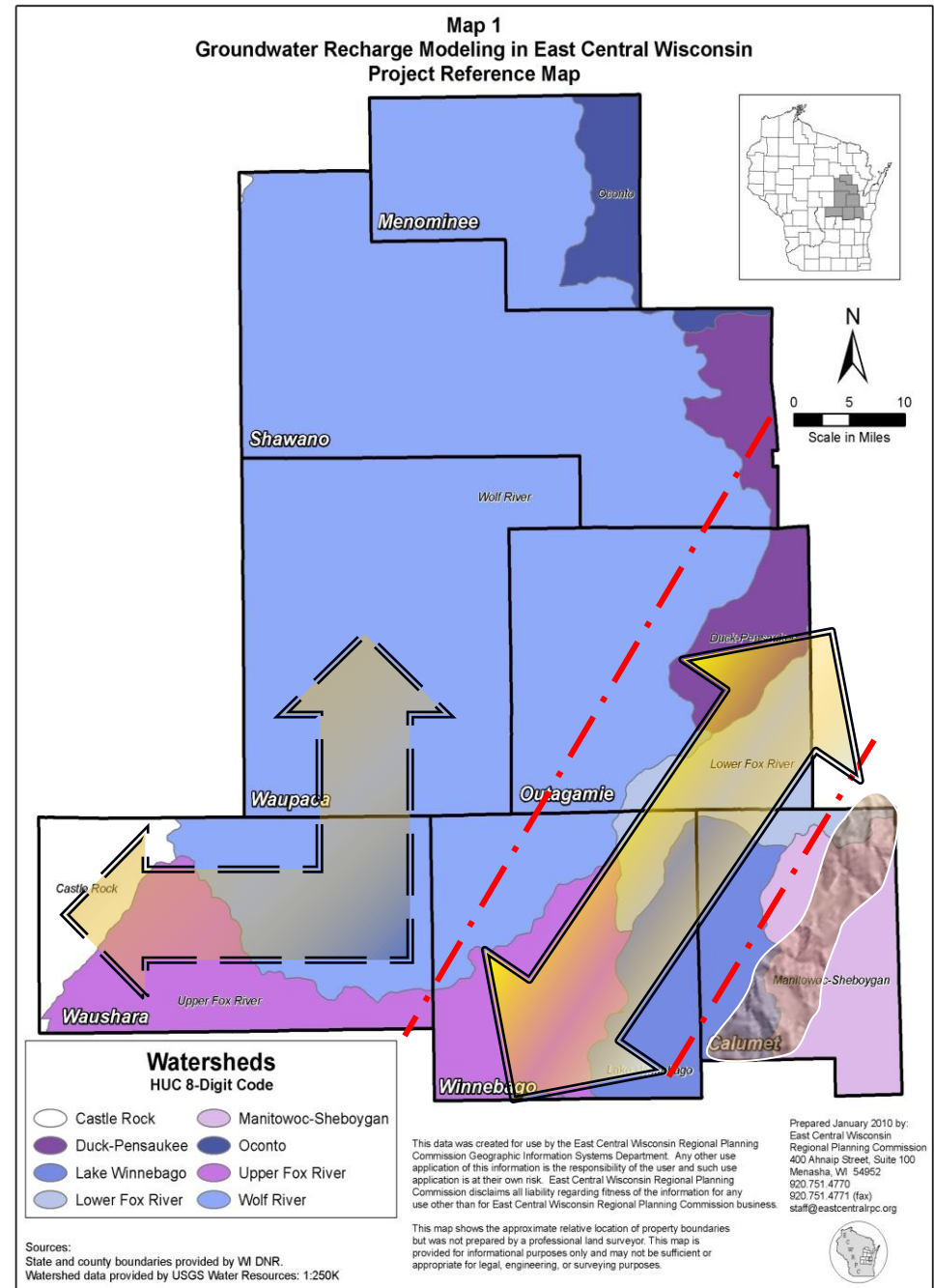
# East Central's Region

- 208 Water Quality Management Planning Area
  - Fox Cities & Oshkosh urbanized areas.
    - Largest population
    - Dense development
    - Impervious surfaces
    - Naturally occurring arsenic in groundwater
    - Stormwater detention vs. infiltration
    - Recent (large scale) flooding



# East Central's Region

- Waushara and Waupaca Counties
  - Sandy soils
  - Large number of high capacity wells (agricultural irrigation)
  - Low/ falling lake and stream levels



# Groundwater Recharge Modeling

## Study Area Features

- Encompass approximately 4,173 square miles (or 2,670,726 acres) within the Lake Michigan Basin
  - Study Area's Watersheds: Wolf, Upper Fox River, Lower Fox River, Lake Winnebago, Manitowoc-Sheboygan, Duck-Pensaukee and the Oconto River Watersheds
- There are a total of 53 municipal water utilities and 30,739 private wells within the Study Area.
  - Approximately 11 billion gallons of groundwater are pumped throughout the Study Area annually.
  - The Study Area's population is projected to increase by 98,130 persons by the year 2030.
    - Based on this population increase, East Central projects an additional pumping need of approximately 2 billion gallons in the next 25-year period (U.S. Census, 2000; DOA 2004; ECWRPC, 1997 & 2004)



# Importance of Groundwater Modeling

- Identify source areas of groundwater.
- Maintain baseflow for healthy surface water ecosystems
  - Groundwater baseflow occurs at constant (cool) temperatures that are important to surfacewater ecosystem.
  - Approximately 80% of Lake Michigan's annual recharge is from groundwater recharge.
- Maintain groundwater levels for water supplies.
  - Need to understand how development changes the hydrologic systems.

# East Central's Region

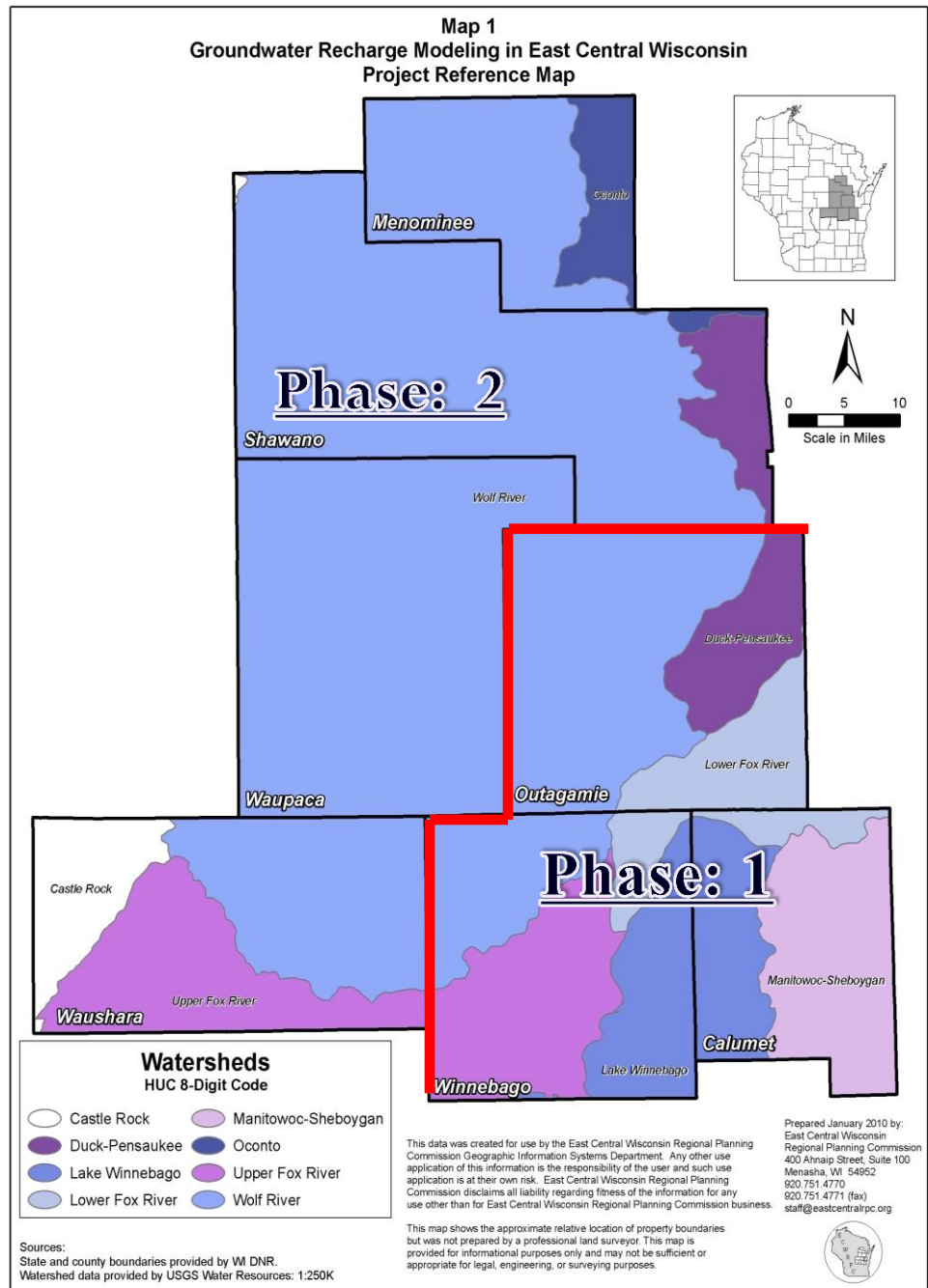
## ■ Phase 1

- Calumet Co.
- Outagamie Co.
- Winnebago Co.

## ■ Phase 2

*(When funding is available)*

- Menominee Co.
- Waupaca Co.
- Waushara Co.
- Shawano Co.



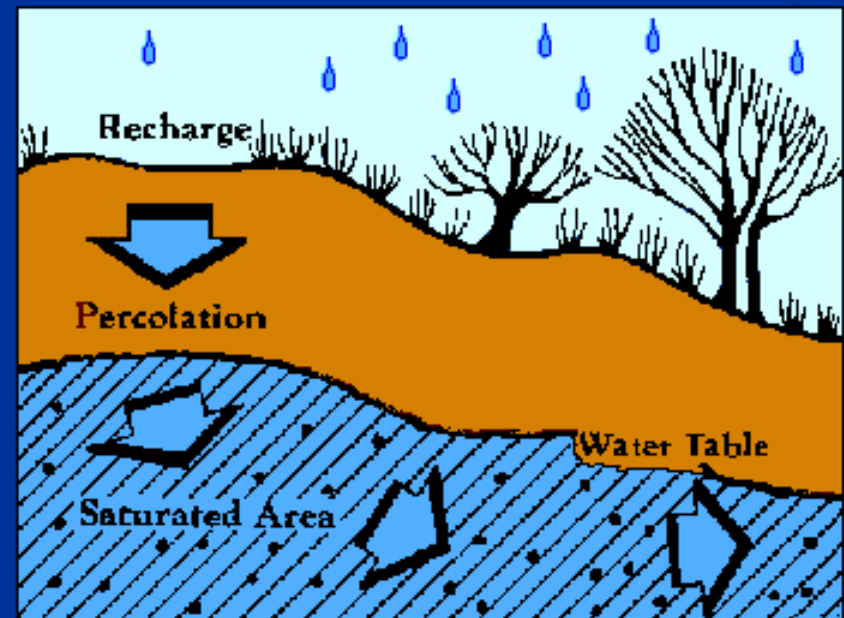


# Recharge from Soil-Water Balance (SWB)

- $\text{Recharge} = \text{Precipitation} - \text{Evapotranspiration} - \text{Soil Storage} - \text{Runoff}$

These different terms can be related to GIS layers.

- Evapotranspiration depends on soils and land cover.
- Soil storage from the soil type.
- Runoff depends on hillslope and soils.



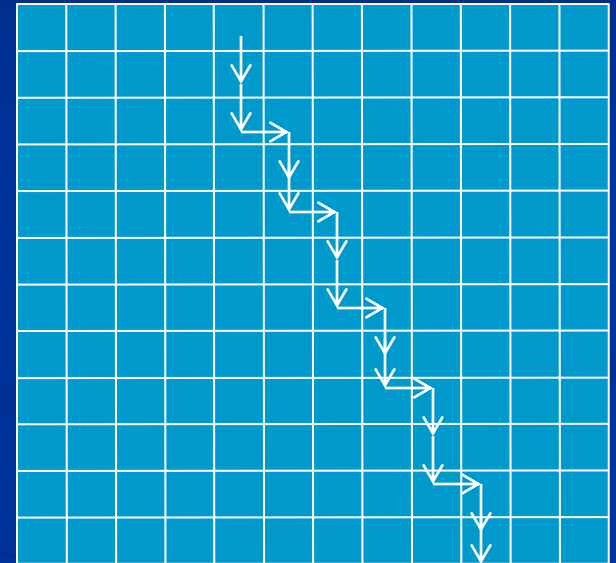
Daniel Feinstein, USGS

Wisconsin Geological and Natural History Survey

# Mechanics of SWB Model

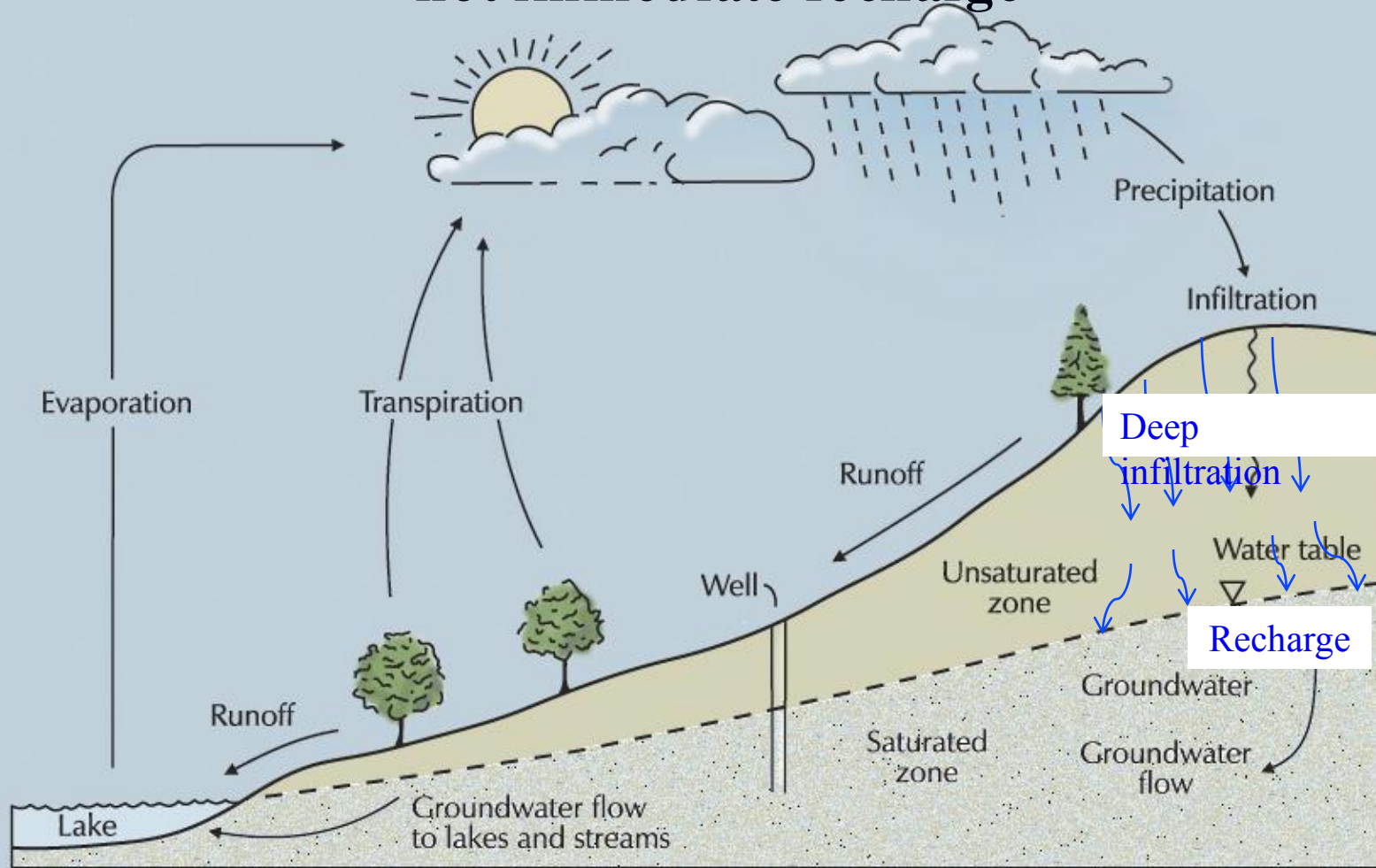
- GIS layers are gridded
- Soil-Water Balance equation applied to cell.
- Excess water (runoff) moved to next down gradient cell and SWB equation applied again.
- Repeat until all runoff is moved to surface water or out of model.

Recharge = Precipitation  
- Evapotranspiration - Soil Storage - Runoff



# Model Actually Estimates Deep Infiltration

not immediate recharge



## Issue of timing

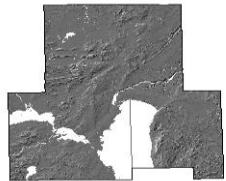
- deep infiltration may stay in the unsaturated zone for an extended period before recharging the aquifer.

# SWB Estimated Recharge

## Climate



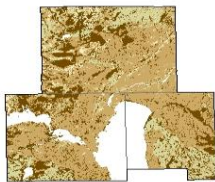
Digital Elevation Model  
Shaded Relief



Data Source: ECWRPC

0 5 Miles

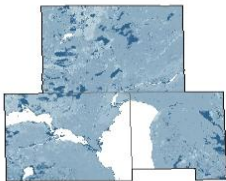
Soil Hydrologic Group



Data Source: NRCS SSURGO

0 5 Miles

Available Water Storage



Data Source: NRCS SSURGO

0 5 Miles

Land Use



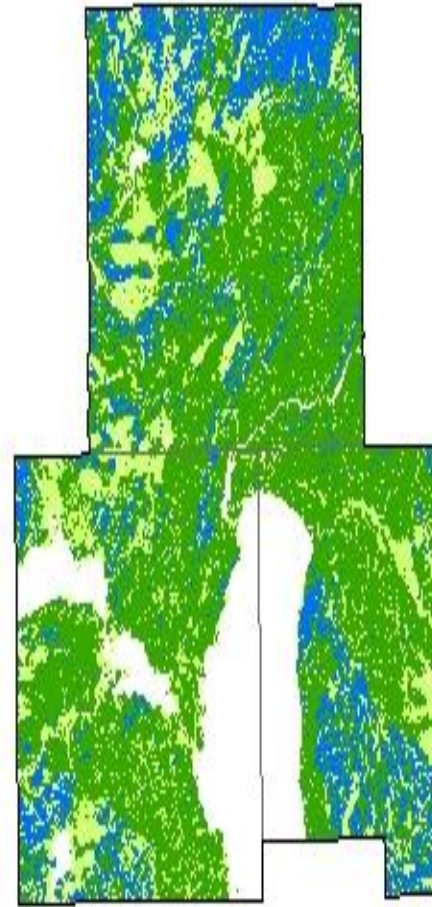
Data Source: ECWRPC

0 5 Miles



## Recharge Potential (Preliminary)

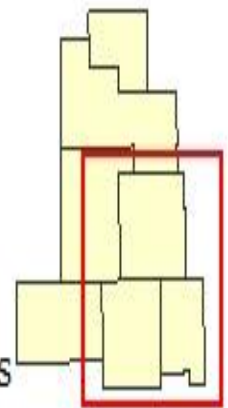
- Low
- Medium
- High
- Very High



Data Source: WGNHS



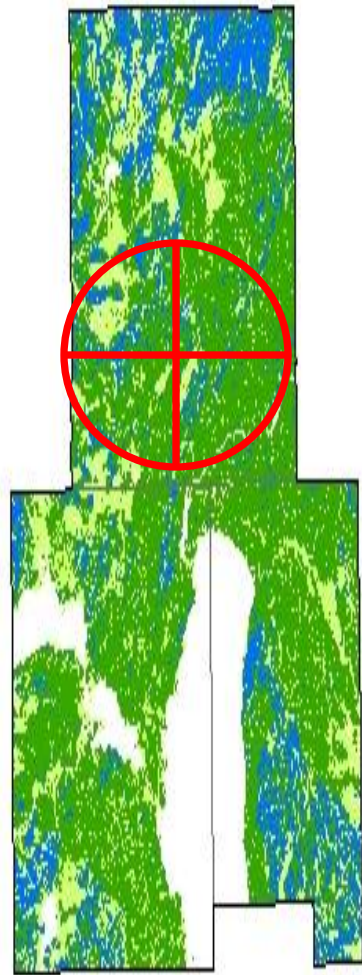
0 5 Miles



EC & Wisconsin Geological and Natural History Survey  
2010 Contract; David Hart, WGNH



# Preliminary Infiltration Maps

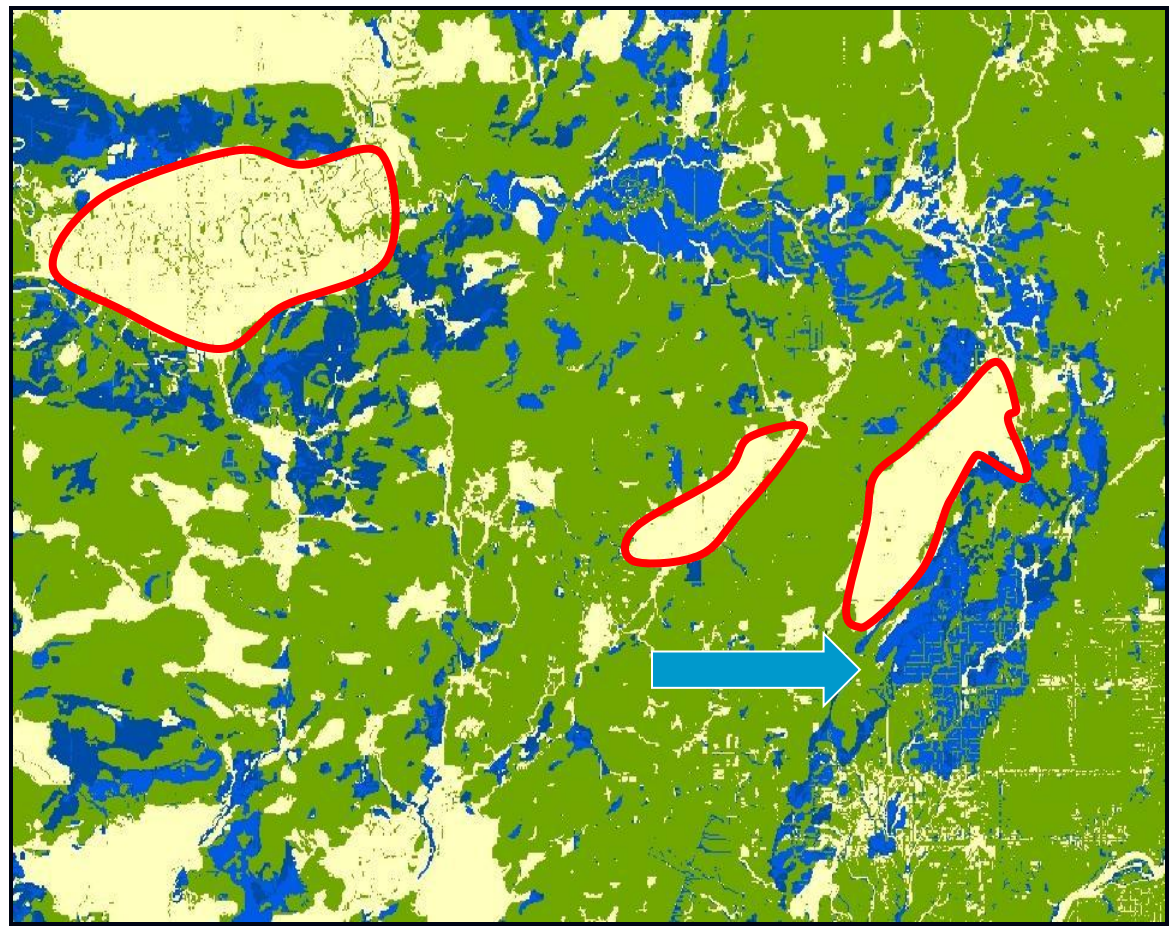


Recharge P  
(Prelimi

- Low
- Med
- High
- Very



0 5 Miles



Data Source: WGNHS



# Control of runoff is essential to maintaining recharge





# Holding Stormwater Hostage

A photograph of a stormwater pond with a thought bubble overlay. The pond is surrounded by dry grass and has a building and power lines in the background. A single goose is visible in the water.

Thanks for the  
new home !

## Creating a new problem

- Perfect habitat for geese
  - No natural predators
  - Large source of food
- One goose can produce about 1.5 lbs. of waste per day. (That means they can 'go' (you know what) approximately 28 times per day).

# Groundwater Infiltration Educational Project

- Highlight Groundwater recharge areas identified within the model.
- Provide alternative BMPs to slow the flow of stormwater and encourage infiltration (i.e., infiltration basins, rain gardens, environmental corridors, etc.
- Will provide examples of ordinance and zoning code language that act as barriers to BMPs that infiltrate stormwater.



Versus





# Ordinance and zoning code review

- Parking lot restrictions
  - Minimum number of parking spots
  - 5" curb around all planting islands
  - Allow flexibility in pavement design and street widths
- Vegetation Standards
  - Height restrictions do not allow for native prairie plants.
  - Tuff grass does not = infiltration
- Building & site design
  - “Screens” = Berms that do not allow infiltration
  - Flexibility to allow for green roofs.



# Other Long-Term Considerations

## ■ Land Use

- Direct development from high infiltration areas.
- Delineate recharge in zones of contribution for wells and surface waters.

## ■ Agricultural Practices

- Reduce field tiling
  - Corn prices up
  - Recent extreme rain events
- Incentive program
  - Return of the seasonal wetlands.



# Four Steps to Create Change!

## 1. First Impression

- EC's groundwater infiltration and stormwater BMPs educational outreach

## 2. Small Step

- Promote and champion individual communities that are interested in doing a better job and get them to take little steps.

## 3. Attitude Change

- Thinking outside the 'Pond'
- Code or ordinance flexibility to encourage stormwater BMPs.
- Develop disconnect incentive programs
  - Rain barrels, rain gardens, green roof, etc.
  - Create land use incentives

## 4. Big Steps

- Making LID and Green Infrastructure the 'New Normal' or the first option when reviewing/ approving development proposals.

# Questions

Todd Verboomen

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